THE CRUSHED STONE JOURNAL

Official Publication
The National Crushed Stone Association

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Foundations for Asphalt Pavements

To Bribe or Not to Bribe

The National Safety Competition for 1929

JULY, 1930

WHY HAVE LOSSES

Poor Grading—High Overhead—Troubles

Ask the following stone producers why they are using NIAGARA ROLLER BEARING SCREENS year after year

Solvay Process Company	Jamesville, N. Y.
Solvay Process Company	Syracuse, N. Y.
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Rock-Cut Stone Company	Ballina, Madison Co., N. Y.
Rock-Cut Stone Company	Jamesville, N. Y.
Rock-Cut Stone Company	Lacona, N. Y.
Rock-Cut Stone Company	Watertown, N. Y.
Mohawk Limestone Products Company	Mohawk, N. Y.
Mohawk Limestone Products Company	Jordanville, N. Y.
Mohawk Limestone Products Company	Mount Vision, N. Y.
BUFFALO Crushed Stone Company	Buffalo, N. Y.
Federal Crushed Stone Company	Cheektowaga, N. Y.
Genesee Stone Products Company	Stafford, N. Y.
LeRoy Lime and Crushed Stone Company	LeRoy, N. Y.
Rhetone Concrete Products	LeRoy, N. Y.
Dolomite Products Company	Rochester, N. Y.
General Crushed Stone Company	Oaks Corners, N. Y.
General Crushed Stone Company	North LeRoy, N. Y.
General Crushed Stone Company	Glenmills, Penna.
Wagner Quarries	Sandusky, Ohio
Wagner Quarries	Castalia, Ohio
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Herzog and Sons	Forest, Ohio
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National Lime & Stone Co.	Spore, Ohio
National Lime & Stone Co.	Carey, Ohio
National Lime & Stone Co.	Lewisburg, Ohio
National Lime & Stone Co.	Bluffton, Ohio
Belle Center Stone Co.	Belle Center, Ohio
Higgins Stone Company	Bellevue, Ohio
Lake Erie Limestone Company	Youngstown, Ohio
Lake Erie Limestone Company	Lowellville, Ohio
Lake Erie Limestone Company	Hillsville, Pa.
Lima Stone Company	Lima, Ohio
Spencer Stone Company	Spencerville, Ohio
Union Limestone Company	Youngstown, Ohio
Ohio Marble Company	Piqua, Ohio
C. C. Beam	Melvin, Ohio
Rock Products Company	Toledo, Ohio
France Stone Company	Holland, Ohio
France Stone Company	Monroe, Mich.
Swint Stone Company	Fremont, Ohio
J. E. Baker Company	Bainbridge, Lancaster Co., Pa.
J. E. Baker Company	White Hall, Baltimore, Md.
New Castle Lime & Stone Company	New Castle, Pa.
New Castle Lime & Stone Company	Dunbar, Pa.
Lehigh Stone Company	Ormrod, Pa.
Stove Trap Rock Company	Pottstown, Pa.
Carbon Limestone Company	Hillsville, Pa.
Blue Stone Quarry Company	Gwynedd Valley, Pa.
Whiterock Quarries	Pleasant Gap, Pa.
Connecticut Quarries Company	Rocky Hill, Conn.
New Haven Trap Rock Company	New Haven, Conn.
Edward Balf Company	Hartford, Conn.
John S. Lane and Son	Westfield, Mass.
West Roxbury Trap Rock Company	West Roxbury, Mass.
Old Colony Crushed Stone Company	Quincy, Mass.
Rowe Contracting Company	Malden, Mass.
Simbrico Stone Company	West Roxbury, Mass.
Casper Stolle Quarry & Construction Co.	East St. Louis, Ill.
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Fanwood Stone Crushing & Quarry Co.	Fanwood, N. J.
Samuel Braen	Patterson, N. J.
Orange Quarry Company	West Orange, N. J.
Granite Rock Company	Logan, Calif.
Daniel Contracting Company	San Francisco, Calif.
Delta Hill Development Company	Kansas City, Mo.
Rock Hill Quarries Company	St. Louis, Mo.
Texas Trap Rock Company	San Antonio, Texas
Dittlinger Lime Company	New Braunfels, Texas
James Stone Company	Corsicana, Texas
Franklin Limestone Company	Nashville, Tenn.
Gager Lime Company	Sherwood, Tenn.
John H. Wilson	Honolulu, Hawaii

CANADA

J. A. Bourbonnais	Vaudreuil, Que.
Canada Crushed Stone Corp.	Puslinch, Ont.
Coast Quarries	Vancouver, B. C.
Dufferin Construction Company	Innerkip, Ont.
Gordon Crushed Stone Company	Hagersville, Ont.
Thomas Langton Crushed Stone	Coldwater, Ont.
LaCie A. Desrosiers, Ltd.	Montreal, Que.
Puslinch Quarries, Ltd.	Puslinch, Ont.
Quinn Stone and Ore Company	Ft. William, Ont.
Rigand Granite Products Company	Rigand, Que.
Stone and Son	Ingersoll, Ont.
Standard Lime Company, Ltd.	Joliette, Que.
Walker Bros.	Thorold, Ont.
Warden King Company, Ltd.	Montreal, Que.

LET US FIGURE YOUR PROBLEMS

NIAGARA CONCRETE MIXER CO.

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BUFFALO, N. Y.

TIME TELLS THE TALE —

BLAW-KNOX BUCKETS ENDURE!

March 20th, 1929.

Blaw-Knox Co.,
Pittsburgh, Pa.

Dear Sir:

The writer has been going over our cost records on equipment repairs the past few days and no doubt it will interest you to know that I find the repairs to our four Blaw-Knox Clam Shell Buckets have been exceedingly low.

Considering that we have had the one half yard bucket nine years, and our last one yard bucket has handled over one half million tons of sand and gravel the repairs and parts purchased to date have been practically nothing. The few replacements which were necessary were received quickly and we had no trouble or inconvenience in making the changes.

Wishing you continued success, we are

Very truly yours,
FROEMMING BROS., Inc.,
By Ben Froemming
Sec. & Treas.

March 8, 1929

Blaw-Knox Company
Pittsburgh, Penna.

Dear Sir:

This is to advise you that our Blaw-Knox Dreadnaught Bucket, purchased in 1921, has given us excellent service.

This bucket has handled 250,000 tons of material during that period. The only repairs made on the bucket during that time was the replacing of two bushings in 1927.

The bucket is still in very good condition and is working at the present time.

Very truly yours
Garvey-Weyenberg Construction Co.
By C. J. Garvey

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Blaw-Knox Company
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EXPORT DIVISION:
Blaw-Knox International Corporation, Canadian Pacific Bldg., New York

London, England, New Oxford House, Hart St., Holborn, W. C. I.—Paris France, 1 Rue de Clichy—Milano, Italy, 6 via S. Agnese, 6—Dusseldorf, Germany, 17 Bismarckstrasse

NOW more than ever Blaw-Knox Buckets are prepared to live up to their reputation for maximum performance with long life and negligible repair requirements. Improvements include Ball Bearing Sheaves which greatly reduce friction and increase operating efficiency and scientifically tempered cutting lips that resist wear to the utmost. Form 1059 describes 43 different Blaw-Knox Buckets in detail—*copy free on request.*

Never Such Screen Cloth for Vibrators

Never such capacity—never such long life—and never such economy as that afforded by ROL-MAN Manganese Steel Screens.

Made of a true manganese steel that has 8 to 10 times the resistance to wear and 2½ times the strength and toughness of ordinary wire. Anchored to any type of vibrator, the exceptionally high tensile strength of the manganese-steel wire gives a live, resilient screening surface that produces maximum output and accurate sizing. No "dead spots" will develop on a ROL-MAN screen if it is properly clamped down.

The unusual wear-resisting qualities of this manganese steel minimize replacements, and make every ROL-MAN screen a profitable investment.

Ask for ROL-MAN by name to be certain of securing the high efficiency and greatly extended life for which these *true manganese steel screens* are noted.

Manufacturers of various types of screening equipment will supply ROL-MAN, if specified, on new machines, or will supply it for replacements of existing machines. Shipments can be made promptly—in most cases 2 or 3 days from receipt of order.

Bulletin No. 120 contains 48 pages of valuable data on the application and operation of screens. It will pay you to write for a copy.

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St. Louis Selected for 1931 Convention

THE annual summer meeting of the Board of Directors of the National Crushed Stone Association was held at the Ambassador Hotel, Atlantic City, N. J., on Friday and Saturday, July 25 and 26, 1930, with a gratifying number of the Board present, representatives of all sections of the industry.

Since the summer of 1925, when the first mid-year meeting of the Board was called by Otho M. Graves, then serving his first term as president, to consider the advisability of establishing a Bureau of Engineering and of moving the Association's headquarters to Washington, D. C., it has become increasingly necessary with the rapid growth of the Association and its activities to have the Board of Directors gather once a year between annual conventions to give earnest and thoughtful consideration to the administration of Association affairs.

One of the most important decisions to come before the Board at its summer meeting is to determine the city in which the annual convention is to be held. As each successive year passes the selection of a convention city is rendered more difficult both because of the natural increase in the size of the meeting, particularly with regard to the Manufacturers' Division Exposition now requiring approximately 100 booths and because of a growing appreciation on the part of the hotels and cities throughout the United States and Canada of the desirability of acting as host to the annual convention of the crushed stone industry.

Literally scores of invitations for the 1931 meeting were received and in many instances the desire was expressed to have personal representatives appear before the Board. To extend such a privilege in general would soon become burdensome, and deprive the Board of the time neccessary to properly consider other matters to which it must give attention. Consequently preliminary to the meeting a weeding out process must take place and the few cities surviving are extended the courtesy of having personal representatives talk to the Board.

This year it early became apparent that St. Louis and Pittsburgh would be the chief contenders. Representing Pittsburgh, Mark Egan, Manager, Convention Division of the Chamber of Commerce and F. L. Andrews, Manager, Wm. Penn Hotel made eloquent appeal for the 1931 meeting while St. Louis' invitation was admirably presented in person by Fred L. Rein, Director of Conventions, St. Louis Convention and Publicity Bureau.

That the Board did not consider lightly its obligation to use discriminating care in the selection of the convention city is evidenced by the fact that after hearing the representatives from Pittsburgh and St. Louis on Friday morning final decision was postponed until Saturday morning thus making certain that a selection would only be made after the most careful consideration.

Many excellent arguments were advanced by the advocates of both cities and it finally determined the Board to hold the Fourteenth Annual Convention of the National Crushed Stone Association at the New Hotel Jefferson, St. Louis, Missouri on January 19-22, inclusive, 1931.

St. Louis has now been officially designated by three of the major industries in the construction of highways as the meeting place for their 1931 meetings. These conventions will take place in St. Louis during successive weeks in the following order:

American Road Builders Ass'n. January 12 - 16.
National Crushed Stone Ass'n. January 19 - 22.
National Sand & Gravel Ass'n. January 27 - 29.

Report of Officers

Comprehensive reports covering activities during the first six months of the year were submitted by the Director of the Bureau of Engineering, the Treasurer and the Secretary. Space does not permit of a detailed description of these reports but the following should be of interest to the membership.

The principle activities of the Bureau of Engineer-

ing included publishing articles of benefit to the crushed stone industry; acting for local groups of producers and for individual producers on technical matters pertaining to the use of crushed stone (conferences in connection with state specifications were held with the following State Highway Departments: Ohio, Indiana, Pennsylvania, Michigan, Georgia, West Virginia, Delaware, Illinois, New York and the District of Columbia. Visits were also made to the cities of St. Louis and Detroit); representing the industry on technical committees; general correspondence; presentation of papers before local groups of producers and technical organizations; laboratory research; special field investigations involving concrete aggregates.

Mr. Goldbeck closed his report with the following interesting comment: "The greatest benefit to the members of the Association is to be derived from that portion of the work of the Bureau of Engineering which is of a basic nature. Such work benefits the industry as a whole. The study of fundamental problems in the laboratory, such as the stability of bituminous mixtures, the development of a proper soundness test, the development of a method for beam testing and the design of concrete having a given beam strength, the publication of technical information, the development of a size standard, etc., are all projects having broad, general application. These, and projects of a similar nature, are the most important pieces of work of the Bureau and are of the highest possible value to the industry. This is the type of work which should proceed continuously and it is to be hoped that the Bureau of Engineering will be able to devote a con-

Among those present at the Board of Director's Meeting, Ambassador Hotel, Atlantic City, July 25 and 26

siderable amount of its time in the future to problems of this nature, in addition to the important emergency problems of individuals which unavoidably have occupied a large percentage of the time of the Bureau during the past six months."

Mr. Graves, in recognition of the possibilities of benefit from increasing the research work, suggested to the Board the desirability of providing additional funds for this purpose. A definite report on this subject will be made at the coming annual convention.

Finances

Detailed statements covering the financial condition of the Association were submitted by the Secretary and the Treasurer covering the first six months of the year, which showed a decided improvement as compared with conditions a year ago.

The Secretary in his report particularly called attention to the excellent response from the membership in regard to the payment of dues on the basis of the scale approved at the Cincinnati Convention, stating that a very high percentage of the membership had replied and in most cases had accepted the new scale.

In connection with advertising in *The Crushed Stone Journal* he pointed out that the number of advertisers had been substantially increased so that now revenue from advertising practically covers the printing costs of the *Journal*.

Interpretation Committee for Trade Practice Rules Authorized

In reporting for the Trade Practice Committee, Mr. Graves, its chairman pointed out that the Board should take action in accordance with Rule D, Group 2 of the trade practice resolutions of the crushed stone industry approved by the Federal Trade Commission on April 15, whereby the crushed stone industry authorizes the National Crushed Stone Association to appoint a committee to investigate whether these resolutions are being observed, to make complaints concerning alleged violations, etc. Mr. Graves particularly emphasized that such a committee should not be so much a policing committee as one whose function would be largely educational and suggested that it be designated as an Interpretation Committee. A complete and thorough discussion of this question was engaged in by the members of the Board at the conclusion of which it was moved, seconded and carried

That the Executive Committee be instructed to appoint a committee of nine, one member being chosen from each of the following regions:

New England	Illinois
New York	Missouri
Pennsylvania	Southwest
Ohio	South Atlantic
	Middle South

as an Interpretation Committee, and that power be vested in the chairman of that committee to enlarge the committee at his discretion as circumstances may indicate as wise, and also to vest in him the authority to eliminate any member of that committee when considering any complaint in which the interests of that member may in any way be allied so that he may be in any way biased; and further that this committee be required, before bringing and complaint before the Federal Trade Commission, to submit the evidence and its judgment to the Executive Committee, which shall have the power to review the same and decide whether the complaint should be submitted to the Federal Trade Commission."

Further details regarding the activities and personnel of the Interpretation Committee will be given in a subsequent issue of the *Journal*.

The following members of the Board and guests were present at the meeting:

W. F. Wise	W. L. Sporborg
W. M. Andrews	T. I. Weston
O. P. Chamberlain	A. L. Worthen
F. O. Eanrshaw	H. M. Davison
E. E. Evans	E. G. Lewis
O. M. Graves	B. G. Shotton
F. T. Gucker	
W. E. Hilliard	*Others Present*
E. J. Krause	J. R. Boyd
A. S. Lane	A. T. Goldbeck
Thos. McCroskey	P. B. Reinhold
Russell Rarey	N. C. Rockwood
John Rice	L. W. Shugg
James Savage	E. T. Wolf
F. W. Schmidt, Jr.	N. S. Greensfelder

QUICK THINKING

Householder (hearing noise downstairs) "Who's down there?"

Burglar (with great presence of mind) "This is station KDKA now signing off until tomorrow morning at eleven o'clock. Goodnight, everbody."

—*Clipped*

Foundations for Asphalt Pavements[1]

By A. T. GOLDBECK,
Director, Bureau of Engineering, National Crushed Stone Association

THE designing of foundations for asphalt pavements is fundamentally a problem in theoretical mechanics. No really adequate consideration of foundation design is possible without delving into the mathematics of the problem. But the development of satisfactory theory depends upon comprehensive experimental work, and unfortunately, this work has been done only in part. Nevertheless, let us examine the problem in its various aspects, and try to bring to light such theoretical and practical information as seems to exist.

Obviously, the primary purpose of a foundation course under an asphalt pavement is so to distribute heavy wheel load pressures that very little movement or deformation of the subgrade will take place under the unit pressures to which it is subjected. Foundation design is thus complicated by our having to take the subgrade support into consideration, and likewise because we must consider the nature of the traffic. Further, we must not forget that while the asphalt wearing surface affords some protection to the foundation, the behavior of the foundation affects that of the surface course. For illustration, excessive movement of a portland cement concrete foundation, such as results at infrequent but wide cracks or joints, may create wide cracks in the wearing surface that are extremely objectionable. Foundation design, in addition to being a problem in mechanics, may become also a problem in chemistry, because it has been found that in certain instances, especially where excessive water and deep freezing are encountered, the durability of a concrete foundation may become seriously impaired. So-called flexible bases, such as gravel, macadam, and black bases, are also subject to molecular forces, so that the foundation problem is far from simple when all of its phases are considered.

In order to discuss foundation design in an orderly manner it will be taken up under the following heads:

1. Traffic Loads.
2. Concrete Base Design.
   - (a) To Resist Traffic.
   - (b) For Durability.
   - (c) For Effect on an Asphalt Wearing Surface.
3. Bases Other than Concrete.
   - (a) Macadam or Gravel.
   - (b) Black Base.
4. Subgrade and Drainage.
5. The Trends in Present Practice.

Traffic Loads

As a general statement, it is safe to say that bases under asphalt pavements must support the heaviest traffic loads operating over our highways today. It is a fact we all recognize, that the heaviest loads are invariably found in our centers of population, where the asphalt pavement is most largely used. In general, this excessively heavy traffic is comparatively slow speed traffic, and for the most part, especially where the pavements are kept in a reasonably smooth condition, the impact effects are generally not excessive. By this is not meant that heavy impacts are not produced; undoubtedly they are produced under certain conditions. One may see a good illustration of impact effects on the off-traffic side of many manhole covers. Here, foundation failures frequently occur, and are due primarily to the impact produced because of the roughness in the pavement at these spots.

The question must arise in the minds of most city engineers, of just what loads they should build their pavements to accommodate, and of whether they should design all of their foundations everywhere to accommodate the maximum loads. There is one outstanding fact, which has been established through intensive research, namely, that it is the wheel load that must be limited in weight, rather than the gross load of the vehicle. If it becomes necessary to carry excessively heavy loads, this may be accomplished safely by the distribution of those loads on a sufficiently large number of wheels, provided they are not placed closer together than approximately thirty inches. Just what the maximum wheel load should be, is a problem each city engineer will have to decide for himself, by considerations based on his own local conditions. Certain industries require the use of heavy trucks, and if in any locality a great many of the heaviest trucks are used, unquestionably the pavements should be designed to accommodate them.

On the other hand, it is doubtful economy to design

[1] Reprinted from June issue *Engineers and Engineering.*

all foundations in any city merely to support a few of the heaviest trucks at present existing. There are two alternatives under such conditions, namely, to require that the wheel loads on these heavy trucks be reduced, or to confine such trucks to designated streets. There is a trend at the present time toward the use of more than four wheels on heavy vehicles, and this trend, from the standpoint of the highway engineer, should be looked on with considerable favor. There is also a decided trend toward the more extended use of pneumatic tired vehicles, especially among the lighter units. This, too, is a highly desirable trend, because lighter units operate at high speeds, and consequently it is those units, for the most part, that produce high impact effects.

Traffic censuses, which have been taken in various parts of the country, bring out the fact that, except for terminal areas in industrial districts, the 5-ton truck is the maximum size generally selected. This is an indication that this unit is the economical limit in weight. In terminal areas, still heavier trucks are used, but when they exceed 7½ tons in capacity, they are generally carried on more than four wheels. It would seem not at all out of reason that the use of motor trucks having more than a prescribed maximum wheel load, should be confined to certain traffic routes. The pavements on these routes may then be designed to withstand the heaviest traffic permissible; and the possibility of a too rapid destruction of the lighter pavements existing elsewhere will be eliminated.

Concrete Base Designs

(*a*) *To Resist Traffic.* A concrete base is usually thought of as being a rigid slab. Actually no material is perfectly rigid, and as proven by actual measurement, concrete bases bend under the wheel loads of traffic. Stress measurements taken by the U. S. Bureau of Public Roads have shown that, when a wheel load is placed in the middle of a concrete slab, horizontal stresses are created in that slab with compressive stresses in the top and tensile stresses in the bottom. The maximum tension exists at the bottom of the slab directly under the wheel load.

It will readily be understood that the amount of stress created depends upon the bending that takes place in the slab, and that those conditions that make for a short radius of curvature in the elastic curve, makes also for high stress. For illustrations, heavy loads bend the slab more than light loads, and thereby produce higher stresses; if the slab is rigidly supported by an unusually good foundation, it bends but little, and a comparatively small stress is created; if, on the other hand, there is a soft spot in the subgrade, the slab is unequally supported, bends excessively, and a higher stress is produced. If the slab is wide, and two heavy trucks pass one another, and if it also happens that the slab is more rigidly supported at the center than at the sides, there will be not only local stress created under each wheel load, but also high transverse bending stress at the center of the slab, tending to cause a longitudinal crack.

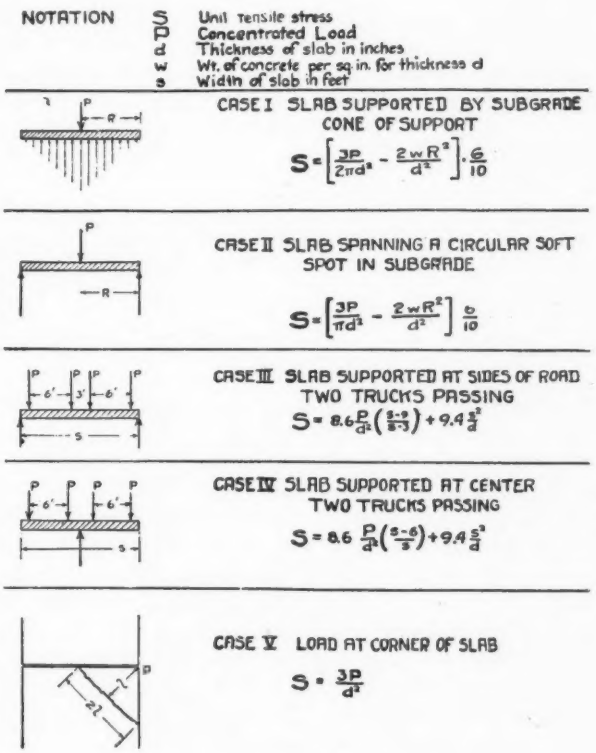
NOTATION
S Unit tensile stress
P Concentrated Load
d Thickness of slab in inches
w Wt. of concrete per sq. in. for thickness d
s Width of slab in feet
CASE I SLAB SUPPORTED BY SUBGRADE CONE OF SUPPORT
$S=\left[\frac{3P}{2\pi d^2}-\frac{2wR^2}{d^2}\right]\cdot\frac{6}{10}$
CASE II SLAB SPANNING A CIRCULAR SOFT SPOT IN SUBGRADE
$S=\left[\frac{3P}{\pi d^2}-\frac{2wR^2}{d^2}\right]\frac{6}{10}$
CASE III SLAB SUPPORTED AT SIDES OF ROAD TWO TRUCKS PASSING
$S=8.6\frac{P}{d^2}\left(\frac{s-3}{s-1}\right)+9.4\frac{s^2}{d}$
CASE IV SLAB SUPPORTED AT CENTER TWO TRUCKS PASSING
$S=8.6\frac{P}{d^2}\left(\frac{s-6}{s}\right)+9.4\frac{s^2}{d}$
CASE V LOAD AT CORNER OF SLAB
$S=\frac{3P}{d^2}$

FIGURE 1

Where intersecting cracks occur in the foundation, corners are formed, which are likely to be broken off under the action of heavy wheel loads; and this is one of the most serious cases of stress possible in any

road slab or pavement foundation. All of these conditions are susceptible of more or less rational analysis, and formulas covering these cases with at least a fair degree of accuracy, are given in Figure 1.[1]

Case I is the usual condition existing in a concrete foundation resting on an adequate subgrade. Case II is a possible case when there is a soft spot in the subgrade. In Cases III and IV, the slab is not uniformly supported, but due to some unusual subgrade condition, rests upon ridges of support. These cases are more apt to occur in concrete highways than in city streets. Case V is a very common case, because concrete foundations develop transverse and longitudinal cracks, and corners are thereby created, it applies to the condition where a load is placed at one of these corners. Cases I, II and V are those most likely to be encountered in base design.

It will be interesting to compare the stresses produced by these various conditions in concrete bases, 6, 8 and 10 inches in thickness respectively, subjected to wheel loads of 10,000 and 15,000 pounds. These are given in Table I. The stress values in the table should

TABLE I

CALCULATED BENDING STRESSES IN CONCRETE FOUNDATIONS POUNDS PER SQUARE INCH

	10 000 Pound Wheel Load			15 000 Pound Wheel Load		
Thickness (inches)	6	8	10	6	8	10
Case I	45	25	16	67	37	24
Case II	90	50	32	135	75	48
Case III (width 20')	—	—	933	—	—	—
Case IV (width 20')	—	—	978	—	—	—
Case V	833	468	300	1250	702	450

not be accepted as having great accuracy. They probably are not far from the truth, and certainly they are very instructive in showing at least what kind of loading is most apt to produce failure. The modulus of rupture of 1:3:6 concrete is probably close to 400 pounds per square inch, and of 1:2:4 concrete, 600 pounds per square inch, at 28 days. The stress developed in Cases III and IV, show that it is useless to try to prevent longitudinal cracks from forming in a 20-foot wide base, when unfavorable conditions of subgrade support exist. Cases I and II do not seem to be particularly dangerous, but Case V shows the danger of failure through the breaking off of exposed corners such as are formed by the interesection of cracks.

In Case I, subgrade support is fully taken into account. Cases II, III, IV and V assume no support from the subgrade. Actually, under Case V, there generally is subgrade support, and depending upon the degree of support, these extreme stress values are somewhat reduced. Moreover, most corners in a pavement foundation are interior corners, which support one another, so we may safely assume that the stresses shown under Case V are generally higher than exist under actual pavement conditions. Also, the pavement surface helps to bridge the wheel load over the crack to adjoining slabs. To offset these alleviating conditions, we must count on the pavement receiving some impact. The net result must be a somewhat smaller stress than shown under Case V; otherwise we would see many more base failures than now occur.

The corner formula shown in Case V is used extensively in concrete highway design, and in general has worked out satisfactorily. There, however, the assumed condition of no subgrade support, is much more likely to obtain than in a city pavement, and the detrimental effect of cracking in a concrete pavement, is greater than in a concrete base. As nearly as can be judged by a general sizing up of the various factors, it looks as if a somewhat higher unit stress, in comparison with the modulus of rupture, than is safe in concrete pavement design, is warranted in base design, to take care of loads of equal magnitude over a term of years.

(*b*) *For Durability.* The question of the quality of the concrete necessary in concrete base construction, is one that has aroused considerable discussion. In various sections of the country, it has been discovered that lean concrete, such as 1:3:6, will not withstand the action of water and freezing. In certain cities, particularly those subject to severe freezing, the concrete base is required to be of a higher quality than is accepted in cities situated in a warmer climate, in order to avoid the tendency of the leaner concretes to disintegrate where the subgrade is wet, and severe freezing takes place. After all, a good indication of the value of concrete bases of different thicknesses and proportions, may be gained by statistics gathered from the various cities; and information of this character will be later presented.

(*c*) *Effect of Base on Asphalt Wearing Surface.* There is much to be considered on both sides of the question of the richness of concrete for pavement bases. Unquestionably, in general, a richer concrete than 1:3:6 will give greater slab strength, and will also produce concrete of greater durability, particularly under wet subgrade conditions in freezing climates. Here, a richer base should be used; but under more favorable conditions, the case is not so clear, because the richer base may have a very decided effect on the wearing surface itself. A rich base, having high ten-

[1] "Thickness of Concrete Slabs" by A. T. Goldbeck. See April, 1919, *Public Roads.*

sile resistance and resistance to bending, does not crack as frequently as a lean base; and consequently the movement of the ends of the slabs at these cracks is larger than is the case with the more frequent cracks in lean bases. The cracks in the rich base are also wider, and in many cases, are transmitted to the wearing surface. This, if too pronounced, is undesirable; for it is much safer to maintain the wearing surface in an uncracked condition, thereby sealing the subgrade from the ingress of water. From this standpoint, there is something in favor of the leaner base with its more frequent cracks. Just how serious may be the character of the cracking in an asphalt wearing surface, induced by the richness of the base, is a subject upon which there should be much discussion. It is important and should be discussed in the light of observation and experience.

Let us see if the known information about the expansion and contraction of concrete will show any difference in the behavior of rich and lean bases. We know that concrete shrinks upon drying out, and investigators agree pretty well that the richer the mix, the greater will be the shrinkage of the concrete. The percentages of contraction observed by some investigators are given in Table II. Although the results are not strictly comparable, because of different test conditions, they show at least that the difference in shrinkage between 1:3:6 and 1:2:4 concrete is not great; perhaps one is not more than 20% greater than the other. If 1:2:4 concrete were to shrink 0.04%, 1:3:6 concrete would shrink perhaps 0.032%. In 100 feet, if the concrete held together, the crack opening in the 1:2:4 concrete would be 0.04 foot, or 0.48 inch, and in the 1:3:6 concrete, it would be 0.032 foot, or 0.38 inch. To the above must be added temperature contraction of 0.66 inch for 100° fall in temperature. Both of these cracks are too wide, and either would be dangerous to the pavement.

TABLE II

PERCENTAGE OF CONTRACTION

Mix	Air[2] 58 days	Air[3]	182 days[4]
1:1	0.046		
1:2	0.049	0.11 (310 days)	0.085
1:3	0.050	0.11 (310 days)	
1:1:2	0.036		
1:2:4	0.033	0.065 (800 days)	0.040 (1:2½:4)
1:3:6	0.036	0.060 (800 days)	0.037 (1:2½:5)
			0.034 (1:3:6)

(2) Matsumoto, Univ. of Ill.
(3) Goldbeck and Jackson, Bureau of Public Roads.
(4) Hatt, Purdue University.

When shrinkage takes place, the slab slides over the subgrade, and immediately meets frictional resistance causing tensile stress. The stronger the concrete, the greater will be the length of the uncracked slab. Tensile resistance of concrete equals roughly 1/12 of the compressive resistance, and that of 1:3:6 concrete is roughly only ½ that of 1:2:4 concrete. Admittedly and of necessity, these figures are approximate. It would seem it is the lower tensile strength of the 1:3:6 concrete that results in more and finer cracks than in 1:2:4, rather than the slightly smaller shrinkage factor of the leaner concrete. Herein lies the possible advantage of the lean base over the rich base, provided it is strong enough to carry the traffic, and durable enough for the existing subgrade and weather conditions.

Bases Other Than Concrete

Gravel, Macadam and Black Base. The two general types of bases other than concrete, most widely used under the asphalt type of pavement, are the gravel or macadam, and the black base, generally of a premixed concrete type. Both of these types demand that the subgrade support be excellent; for neither macadam nor black base have any considerable slab resistance under statically applied loads, although under moving loads they all probably develop a momentary resisting moment. Their load distributing ability is gained very largely through their resistance to shear, and in the case of the macadam base, the more compact such a base is, the greater is its resistance to loads. Black bases have been in service over a long term of years, apparently with very satisfactory results when they have been properly supported. When the subgrade support is not favorable, a subfoundation of granular material, whether of bank-run gravel, crushed stone, or slag, should be used to provide the thickness necessary for properly decreasing the unit pressure on the subgrade.

No thorough investigations have ever been made to show the relative load distributing values of the macadam base or black base, and the concrete base. Tests made by the author have been quoted at various times to show that, under a given thickness of macadam, the unit pressure intensity was some eight times that transmitted through an equal thickness of concree. This figure should not be accepted as of universal application, for, as a matter of fact, the broken stone layer used in the tests was compacted by hand methods, which did not give the degree of compaction to be obtained by rolling, and by the subsequent action of traffic. Moreover, the tests were made for only one subgrade condition, and therefore, they should not be re-

garded as anything more than an indication of what the relative pressure transmitting properties of these respective bases actually are. Just what constitutes equivalence in base design for these respective types, probably can be arrived at only through actual service tests under the particular conditions existing.

Subgrade and Drainage. It is axiomatic in highway and street construction that the subgrade should be kept as dry as possible. With some exceptions, almost any soil will offer good subgrade support, if it is kept sufficiently free from moisture. In some cases, the elimination of water from the subgrade is difficult; and in these cases, there is a tendency to resort to means for altering the characteristics of the subgrade by the provision of a granular layer, which may be composed of cinders, bank gravel containing very little clay, or well filled crushed stone or slag. In highways, so-called traffic bound construction serves as an excellent subgrade treatment, because under the action of traffic, the aggregates used become mixed with the subgrade and thoroughly compacted in thin layers. This treatment does not lend itself as readily to city pavement construction, except in the outlying districts, where it is frequently employed for the temporary carrying of traffic before paving, and results in a subgrade greatly superior to the original.

In cities, not enough attention is paid to adequate drainage, particularly in streets bordered with high terraces. Here, subgrade troubles are frequently visible, and the remedy is adequate tile drainage along the sides, to intercept the water seeping in from the exposed terraces. Some soils, notably the extremely finely divided clays, are known to give trouble; because if they become sufficiently wet, they are plastic, and have little load carrying capacity. Moreover, they exhibit great change in volume, shrinking when they dry out, and expanding when they again become moist. Were this volume change uniform at all times and in all places in the subgrade, no particular damage would result. But soils are notoriously heterogeneous in their structure, and the consequence is that unequal changes in volume ensue. The resulting motion is transmitted to the pavement with detrimental results. Under such conditions, increased thickness of the foundation course is not particularly effective, and successful use has been made of granular treatments from four to twelve inches in thickness.

The reinforcement of bases laid on such soils is also of benefit, not that the reinforcement prevents cracking particularly, but at least it will tend to maintain the base in a smoother condition than would otherwise be the case. Reinforcement has been used successfully also abroad, in black base construction over soft subgrades.

The Trends and Present Practice

A great deal of useful information has recently been gathered at considerable expense by the American Road Builders' Association, not only on base construction, but also on a number of other matters pertaining to pavements. It will be interesting to list some of this information. (See Table III).

In answer to the American Road Builders' Association questionnaire, Little Rock, Arkansas, replied that its experiences with black base were unsatisfactory. Los Angeles uses asphaltic concrete under asphalt wearing surface. Oklahoma City uses black base, but states it is not cheaper than concrete; also uses six inches of gravel. Pittsburgh uses black base in business streets—costs about the same as concrete—time element a factor. Portland, Oregon, uses asphaltic concrete black base on residence streets of four inches minimum thickness. Toledo has constructed one street with black base, but has no results of interest as yet. In Trenton, black base is used where necessary to keep traffic moving, its cost is greater than concrete.

With regard to macadam base, most of the cities reported it is not used under asphalt pavement. Dallas uses macadam base six to eight inches in thickness, and Portland, Oregon, uses it on fills with a six-inch thickness.

To sum up the present trend in base design, apparently most of the cities are still adhering to a comparatively lean mixture, except in those localities where there is danger of disintegration from frost action. Not so many years ago a 6-inch, 1:3:6 concrete base was considered the standard under asphalt pavements, but it will be noted that many of the cities are now using eight inches and some of them as high as ten inches. Reinforcement is used primarily in those localities where bad subgrade conditions obtain. Apparently, many of the cities are bgeinning to use expansion joints, some of them reporting good results.

There are several items in base design the service results would seem to indicate are in need of some revision. For illustration, wherever manholes occur in asphalt pavements, it is almost certain that in time these will project up beyond the level of the pavement, and consequently create conditions making for severe impact. This fact should be recognized; and it would seem to be wise that the pavement base be made thicker

TABLE III

INFORMATION ON BASE CONSTRUCTION GATHERED BY THE AMERICAN ROAD BUILDERS ASSOCIATION

Cities	Thickness Min.	Thickness Max.	Reinforcement Used	Whether Expansion Joints are Used	Slump	What Strength of Concrete is Required at 28 Days.
Baltimore	6" Std Thickness		No	No	1½ — 2½	2000#, obtain 2500 to 3400#
Chattanooga	5"	7"	No	No	1 — 2	No strength required
Cincinnati	7"	9"	No	No	2 — 3	2100#
Columbus	6" all cases		No	No	2 — 4	——
Dallas	5"	7"	¾" bars, 36" centers laterally, 4 or 5 bars longitudinally	No	2	1800 to 2000#
Dayton	6"	8"	No	No	2	3200 to 5100#
Detroit	8"		No	No	3	2500#
Flint	7"	10"	Yes, 42# prevents cracks	Metal Transverse Expansion Joints	3 — 4	2500#
Jacksonville	6"		No	No	2	1500#
Kansas City	8" Std. base		No	Transverse and longitudinal along curb. Precast joints.	3	2000#
Knoxville	6"	9"	No	——	1 — 3	2500#, reinforced concrete 3000#
Little Rock	4½"	6"	40#-42# mesh, concrete foundations, when ordered by engineer.	No	—	2000#
Los Angeles	5"	8"	No	No	3	1000#
Mansfield	6"		No	Yes, patent steel guard	—	2000-3000#
Oklahoma City	6"	8"	No	——	1 — 2	——
Philadelphia	all bases	8"	No	No	½ — 2	Not specified but averages 1750#, minimum 1450, maximum 2050
Pittsburgh	6"	7"	Yes, 60# mesh over embankment of more than 4 ft. and fresh trenches.	No	2	Equal test specimen
Portland	5"	10"	Yes, 68#, 4 years	25 ft. spacing, asphalt treated felt	3	——
Richmond	6"	8"	42# mesh over ditches and wet places.	No	Less than 3" About 1"	Varies
Cleveland	6"	8"	Yes, for bituminous pavements.	No	1 — 2	2000#, obtain 2800-3500#
St. Louis	6"	9"	No	No	2	——
Toledo	7"	8"	No	No	1½ — 3	1500#
Trenton	6"	8"	No	No	1½ — 2	No strength specified
Washington	7"	9"	No	No	¾ — 2	2600#
Wilmington	5"	6"	No	No	1½	2800#
Worchester	6"	8"	Heavy weight mesh	Precast and poured, both satisfactory	2 — 3	——
Chicago	6"	8"	No	⅜" preformed joints, elastite where granite block is used.	—	Not specified
Cumberland	5"	7"	At times	Premolded joints used, both longitudinal and transverse, good results.	—	——
Seattle	5"	6"	No	Through joints, longitudinal and transverse	2	4000#

or stronger in the vicinity of manholes, and perhaps also reinforced with heavy mesh. The question of the proper back filling of trenches, and the replacement of the foundation, does not seem in all cases to have been properly attended to.

Quoting from the report by Chas. E. Reppert, of Pittsburgh, before the annual meeting of the City Officials Division of the A. R. B. A.: "Every city in our survey has recognized the importance of properly backfilling trenches cut in the subgrade, by requiring some special method for backfilling or even the use of special backfilling material.

"Where the soils are granular, such as sands or gravels, puddling is the usual method used for compacting the backfill. In some cases, the material is placed back in the trench kept filled with water; in other cases, the trench is first filled, and then the water applied on top. Plastic soils, such as clay, gumbo, and adobe, are tamped in relatively thin layers. Trenches in rock and some clays are backfilled with sand, slag,

gravel, or broken rock. Four cities reported requiring the use of mechanical tampers.

"The puddling of sand and gravel subgrades seems to be the general practice for compacting the subgrade, especially for finding those soft, uncompacted spots usually caused by excavations having been made and not properly backfilled. Only one or two cities reported the practice of puddling clay subgrades. Compacting the subgrade with a roller weighing approximately ten tons, seems to be the almost universal practice reported from those cities having clay, gravel, and other compressible subgrades. The heavy roller finds the soft and weak places in the subgrades. There is always the possibility that too much rolling with a heavy roller may over-compress the soil in spots, with the result that, in regaining its normal structure, it may expend, causing the subgrade to exert an unequal pressure on the pavement base. In a few cities, rollers weighing as little as five tons are used, and one city reported using fifteen-ton rollers. Light rollers are used when the subgrades are soft.

"Dallas, Texas, was the only city reporting subgrade of insufficient supporting power, for which no adequate remedy has been found. The soil is a black, waxy material.

"When small areas of the subgrade are incapable of supporting the pavement with its traffic loads, the unstable material is generally removed and replaced with cinders, slag, gravel, or other suitable material; and usually additional drains are installed.

"The cushion blanket course, as a means for overcoming many of the deficiencies of a subgrade, is recognized in more than one-third of the survey cities reporting plastic subgrades. It may be made from cinders, sand, gravel, broken slag, or slag screenings, in thickness varying from two inches to twelve inches. Four inches to six inches is the usual thickness. A well drained porous yet solid layer of material, four to six inches thick, below the pavement base, intercepts the rising capillary water, and carries it to the drain. Such a layer of porous material acts also as an insulator, to prevent the frost from penetrating deeply into the subgrade, and helps in distributing the traffic loads when the subgrade may be soft."

With regard to the pavement base over trenches, Mr. Reppert reports almost every city in the survey increases the beam strength of the concrete base over newly backfilled trenches. Those cities that do not increase the beam strength, have special requirements for backfilling of the trenches.

The writer would call attention to the fact that, when a narrow trench is cut in a pavement, and the foundation course of concrete is replaced, there necessarily results a comparatively narrow beam or slab, which, because of its narrow width, has low resistance to bending. It would seem that three things should be done to insure that this portion of the base will not fail in the future. First, the strength of this concrete should be increased over that of the surrounding pavement. Second, it should be provided with reinforcing steel. Third, the edges of the concrete on each side of the trench should be so shaped as to support the newly laid concrete covering the trench. In this way, should subsequent settlement of the trench take place, the foundation will safely bridge the gap, notwithstanding its lack of subgrade support.

Conclusion

In conclusion, it is to be regretted that foundation design is not amenable to rigorous mathematical analysis, such as may be applied to bridge structures, but the difficulties of analysis and many variables that must be included have thus far prevented the development of an entirely rational theory; although a long step forward was made in this direction in concrete road design, through the use of the theory that the concrete base should be designed as if it were a beam of uniform strength, as shown in Case V in the preceding discussion.

For base design, there perhaps is no more reliable source of information at present than that obtained through questionnaires covering present practice, and the American Road Builders' Association is to be highly commended for the good work it has accomplished in this way. The trends in practice revealed by these questionaires may be taken as a safe guide, when studied in connection with local conditions.

Virginia Highway Work Valued at $16,000,000

Highway construction and maintenance work costing approximately $16,000,000 is in progress in Virginia, according to a statement by the highway commissioner, Henry G. Shirley, issued by the director of the budget, J. H. Bradford.

"At the present time there is something like $13,000,000 value of construction work going on and about $3,000,000 in maintenance," the statement said. "The greater portion of this work will have to be completed during the Summer and Fall months."

To Bribe or Not to Bribe?[1]

By Pyrodes Querpo

THAT the idea of commercial bribery, either direct or indirect, is repellant to every reputable business man does not permit of argument. Yet it is a fact that, in almost every selling field where the unit of sale is large, the question of extending personal inducements to certain buyers comes up all to frequently.

The problem would be solved, of course, by complete unanimity of all manufacturers in any field in absolutely renouncing such practice and sticking conscientiously to this policy. The difficulty is that when they meet in conference, they readily agree to this course, but the next week their sales representatives are back again at their old tricks.

Some large organizations face the selling necessities in their field as a condition, not a theory, and do not mince words in admitting that they do whatever is necessary to make a desired sale. The great majority, however, of those who look favorably on such methods of getting business adopt the Pharasaical attitude of discountenancing bribery officially, but making such arrangements regarding commission percentages and expense accounts as to make it possible for individual salesmen to "take care of" the buyer when this course seems indicated.

According to this plan, the company and its officials "know nothing whatever" about any arrangements. Whatever the individual salesman cares to do is "his business." The firm is only interested in the signed purchase order he brings in.

Within the scope of "personal inducement" there fall not only direct money bribes, but also lavish presents, extravagant entertaining, and so forth. It is true, of course, that standards of business practice and commercial integrity have been raised greatly during the last few decades. But we should not close our eyes to the fact that there is much more progress still to be made. That the situation shall continue to improve is to the interest of every reputable business man.

On the other hand the manufacturer in some fields faces a real dilemma—whether he shall close his eyes to bribery in one form or another or whether he shall take a militant stand against it. If his personal standards of honor preclude his adopting any but the latter course, he pays dearly in loss of business for sticking to his principles.

I do not pretend to know the actual conditions in all fields, but I do know them in at least one field. In this field there are four or five companies of importance doing business national and international in scope. The president of the company with which I am associated, decided at the beginning that the organization would operate on certain fixed principles and succeed if possible or fail if necessary before those principles would be departed from.

The features of the code thus determined upon which bear upon the subject of the present discussion were these:

1. Our product will be sold at a fixed price which will be the same to every one.
2. We will sell our product on its merits only, deal with prospective customers as one businessman with another.

The first rule was established in fairness to the man who does not haggle—who considers a proposition and accepts or rejects it without cavil. The cheap bargainer gets no advantage over him. One of our individual sales-managers went into the field in the endeavor to close an important deal with the owner of a chain of enterprises from which we could logically expect a quarter of a million dollars worth of business. The equipment involved in the first transaction to be discussed totalled $30,043.80. The matter was argued pro and con and finally the buyer said: "Knock off that odd forty-three dollars and I will give you the order."

Our representative said: "Mr. Jones, please do not ask me to do that, for I cannot. I will do many other things to be helpful to you, and to make this installation successful, but we have a definite policy on that point from which we cannot depart."

"You mean to say," rejoined the buyer, "that if you wire this offer to your main office, they will turn down the order on those terms? Why, if you have to make

[1] From the May, 1930 issue of the *Rotarian*.

another trip out here to close this deal, it will cost you more than that in railroad fare."

"Not only would they decline it but they would severely censure me for even asking the question," was the reply.

The buyer thought carefully for a moment, turning the matter over in his mind. "Well," he drawled, "if you folks can do business on that basis you must have something worth buying. I have never had a suggestion like that turned down since I have been in business and I must say I respect you for your stand. Give me that contract to sign."

This reminds me of a story regarding the late Benjamin Altman, a pioneer in the crusade for fixed prices, clearly marked for all to see. A customer of long standing came in to look for a large rug. He had found just what he wanted but the price was higher than he felt he could pay. The head of the department knew that this particular rug would be marked down two weeks later to a price the customer was prepared to pay. The latter, however, was leaving for Europe in ten days.

Asking the prospective buyer to excuse him for a moment, he went to his chief's office, explained the circumstances, and asked whether the reduced sale price could be offered now. Mr. Altman looked at him sorrowfully and said: "You have been with me for fifteen years and you have not learned yet that the price on our tickets is the only price at which our goods are for sale!"

Are these two incidents representative of pigheadedness or of sound business policy? I think the majority of successful merchants and manufacturers will respect the organization that adopts what they believe to be a right policy and sticks to it through thick and thin.

We turn now to the second principle of the code of the manufacturer we have been discussing—to sell on merit only, holding out no inducements other than the advantages which will accrue to the buyer through the use of the equipment purchased. Of course, there is never any question about personal inducements with the principal executives of the firms with which we deal. But our preliminary negotiations are with foremen and superintendents in the mechanical departments—men who are earning from sixty to a hundred and fifty dollars a week. In most cases, unless these men recommend and request the purchase of our equipment, there is not much hope of a sale. Then again if the "higher-ups" make a decision contrary to the recommendation of their mechanical men the latter can very easily "queer" the equipment when it is put into use.

Our representatives go to these men and give them full information regarding our equipment. In many instances our goods have preeminent advantages which should make a favorable decision inevitable. Our salesmen are ready to make surveys, run specimens of their product on our machines, show them equipment in use in similar plants—in fact, go to any trouble and expense to put them in possession of facts which should be conclusive. Yet in many instances they do not "get to first base."

Why? When we inquire carefully into such situations we get this kind of information. "In order to get in there," says one salesman in a related line, "you will have to fix Jack to the tune of five per cent of the purchase. He expects it on all equipment they put in." Or, from another source: "Didn't you know that your competitor had Bill down to New York for a week on a "whoopee" party he will never forget. He feels pretty cordial toward that fellow." Or friendly advice like this: "The other men in your game send Jim a case of liquor every month. If you want to get by with your proposition, I advise you to do the same."

Under these circumstances, what is an ambitious salesman to do? Not only does our company omit to provide funds for "persuasive selling" of this character, but it forbids its salesmen to adopt these methods on pain of instant dismissal, even when they pay the expense out of their own commission. They must sell our equipment like reputable businessmen, or lose the sale.

We lose many sales because of adherence to this principle, the total volume so lost probably amounting to half a million dollars a year. If this lost business were put on our books the added profit would pay many times over for the irregular selling expenses involved.

These lost sales are discouraging to the men on our sales force, when they see less-worthy products represented by less capable men, getting the business.

At trade conventions which the superintendents and foremen attend, a number of our competitors maintain "open house" in a suite of rooms in the headquarters hotel, dispensing generously hospitality of a kind which is supposed to have been legislated out of existence. Our men attend these conventions, are cordial to everyone, will talk serious business when opportunity offers, and will take customers or prospects to lunch or dinner—but no more. The result is they are regarded by many men in the trade (though not all) as "poor sports" or "cheap skates," while the

representatives of our competitors are "bully good fellows."

There are some who will say that the situation existing in our field is unusual. I can only say that in two closely related fields regarding which I have specific knowledge, conditions are worse rather than better than in ours.

In one, where the unit of sale is often one hundred to two hundred thousand dollars, I am told that three to five thousand dollars *in cash* has to be provided for "extraordinary sales expense" in each instance. The employees in charge expect this as their due.

In the other, condtions are a scandal. Practically every concern in the United States selling a certain material makes a regular practice of paying the foreman of the department using their goods either ten per cent or fifteen per cent of his company's total purchases each month. The federal authorities attempted to reform this industry and obtained pledges from all the manufacturers to discontinue the payment of regular graft stipends, but soon afterwards conditions became just as bad as before. It is now handled on the books in another way.

The odd thing about this situation is that the owners and executives of establishments in this field know the universality of the practice, but seem powerless to stop it. If they take the buying out of the foreman's hands, the material from another supplier "will not work" and the expense of delays and spoiled product becomes serious. So the employers have become resigned to the situation.

In large establishments this graft mounts to astounding figures. The vice-president of a company selling this material told me the following story.

He had for a number of years been selling the foreman of a large plant, and taking care of him regularly on the ten per cent basis. One day he went to see him and found a competitor's product in use. When he had opportunity to speak privately with the foreman, he said: "Harry, what did they do for you that I couldn't do for you? You know I always tried to play the game."

"I know, you've been fine," Harry replied, "but I couldn't expect you to do what they have done."

"Well, Harry," the manufacturer said, "tell me anyway what they did."

Harry hesitated a moment, then looked up frankly and said, "they bought me a house."

That this question of commercial bribery constitutes a serious problem to many business men cannot be denied. There is no use in claiming, ostrich-like, that graft in business is a thing of the past.

The manufacturer who renounces "inducements" to buyers, generally suffers for his devotion to principle, for bribery is generally a cheap means of making sure of orders, whether the price scale is higher or not.

The real advantage in the policy which we and many other merchants and manufacturers have so steadfastly pursued accrues entirely to the benefit of the customers we sell to. We do not add to the price an allowance for a graft percentage, we do not debauch their employees, we do not carry booze into their work shops. But we do sell as aggressively as we know how, and while our company is increasing its volume almost fifty per cent each year, yet a large volume is being lost to our competitors who play the game according to their own rules.

Is there any hopeful aspect of the problem here outlined? There is one which deserves careful thought.

The real support of our policy should come from the owners and executives of the firms who are our customers. They have a national trade association, which should take an active interest in the situation I have described. The facts I have stated are of common knowledge and could easily be verified by confidential investigators. The president of the association should then tell the executives of the companies selling to its members in this field—in no uncertain terms—that they must mend their salesman's habits, warning them that violations of an ethical code will be reported to all members, and salesmen of the offending concern will be barred from their offices.

Such an admonition, emphatically administered and earnestly followed up, would have an electrical effect on selling practice in this industry. Some prices would come down, along with a reduction in sales expense. There would be much greater probability of the right equipment being selected for specific needs. There would be less underhanded dealing in the industry.

There would be many benefits to the buyers. Incidentally such a revision of practice would probably take a good many worries off the minds of the executives of the selling companies who are now closing their eyes to this petty grafting to promote much-needed sales.

The moral of all this is that the buyer has an imperative duty in fostering high standards of business integrity—a duty which it will be to his financial advantage to perform.

The National Safety Competition of 1929[1]

By W. W. ADAMS
Supervising Statistician, U. S. Bureau of Mines

THE fifth annual National Safety Competition conducted by the United States Bureau of Mines to determine the best safety records at mines and quarries during the calender year 1929 has been concluded, and the general results of the contest are presented herewith. To the winner in each of the five groups into which the contestants were divided there has been awarded the bronze trophy "Sentinels of Safety," donated by the Explosives Engineer magazine. The trophy for bituminous coal mines was won by a mine in Alabama; that for metal mines by an iron-ore mine in Michigan; that for nonmetallic mineral mines by a salt mine in New York; that for quarries and open-cut mines went to a limestone quarry in Michigan; the trophy provided for anthracite mines was, of course, won by a mine in Pennsylvania, as all of the anthracite mines participating in the contest are situated in that State.

Winners of the trophies were selected by a committee of award in accordance with rules governing the contest and on the basis of accident records furnished by the various companies to the Bureau of Mines. These records were summarized by the bureau and the results submitted to the committee. Members of the committee are W. H. Cameron, managing director of the National Safety Council; William Green, president of the American Federation of Labor; James F. Callbreath, secretary of the American Mining Congress; T. T. Read, Vinton professor of mining of Columbia University and editor of "Mining and Metallurgy"; C. B. Huntress, executive secretary of the National Coal Association; A. J. Curtis, assistant to the general manager of the Portland Cement Association; A. T. Goldbeck, director of the engineering bureau of the National Crushed Stone Association.

Thirty-four States were represented in the 1929 contest. Among the plants which participated were 68 bituminous coal mines, 29 anthracite mines, 54 metal mines, 19 nonmetallic mineral mines, all of the foregoing being underground mines, and 141 quarries or open-cut mines. A total of 106,533,006 man-hours of work was reported by all of the companies. Accidents during the year numbered 7,068 and represented a period of disability equal to 986,306 man-days. Hence the accident-severity rate for all plants combined represented 9.3 man-days of disability for each thousand man-hours of exposure to hazard. Similarly, the combined accident-frequency rate for all plants showed that 66.3 accidents occurred for every million man-hours of exposure to hazard. Both of these rates indicated an improvement over the combined rates for all plants in the previous year's contest. The reduction in the accident-severity rate centered chiefly in the metal-mine group, though all except the quarry and open-cut mine group shared in the reduction; the improvement in the accident-frequency rate was in all groups except anthracite and metal, the rate for the former having increased while that of the latter remained unchanged.

Frequency and severity rates for the contest as a whole were not only lower than those for the previous year but were also lower than for 1927. Moreover, the accident-frequency rate for 1929 was lower than for any previous year, being 34 per cent less than for 1925, the year of the first National Safety Competition. Credit for this reduction belongs to all groups except anthracite. On the other hand, the accident-severity rates for all plants combined have not been as favorable during the past three years as they were in 1925 and 1926, owing chiefly to an increase in the severity rates for anthracite and bituminous mines.

Thirty-four States were represented in the National Safety Competition of 1929. These States were:

Alabama	Indiana	Massachusetts	New Mexico	Utah	
Arizona	Iowa	Michigan	New York	Virginia	
California	Kansas	Minnesota	Ohio	Washington	
Colorado	Kentucky	Missouri	Oklahoma	West Virginia	
Connecticut	Louisiana	Montana	Pennsylvania	Wisconsin	
Florida	Maine	Nebraska	Tennessee	Wyoming	
Illinois	Maryland	New Jersey	Texas		

Scope of the Competition

The general scope of the competition is shown by the following figures. As previously indicated, the contest covered the accident records of 311 mines and quarries whose employees worked 106,533,006 man-hours during the year.

[1] Reprinted from U. S. Bureau of Mines Report of Investigations 3019.

Editor's Note: Due to lack of space, only the table covering the Quarry Group is given.

GROUP 5.—ACCIDENT DATA FOR CERTAIN *QUARRIES AND OPEN PIT MINES* IN 1929[1]

Code No.	No.	Hours worked	Number of accidents					Number of days lost					Frequency[2] rate	Severity[2] rate
			Fatal	P. T.	P. P.	Temporary	Total	Fatal	P. T.	P. P.	Temporary	Total		
1	1	753,156											.000	.000
2	2	361,979											.000	.000
3	3	361,241											.000	.000
7	4	200,517											.000	.000
8	5	197,327											.000	.000
9	6	194,233											.000	.000
10	7	192,772											.000	.000
11	8	189,678											.000	.000
13	9	166,876											.000	.000
14	10	156,770											.000	.000
15	11	146,280											.000	.000
16	12	128,368											.000	.000
17	13	125,417											.000	.000
18	14	124,423											.000	.000
19	15	123,928											.000	.000
21	16	115,918											.000	.000
22	17	111,889											.000	.000
23	18	111,443											.000	.000
26	19	105,692											.000	.000
27	20	104,562											.000	.000
28	21	102,032											.000	.000
29	22	100,158											.000	.000
30	23	98,260											.000	.000
32	24	78,653											.000	.000
34	25	76,200											.000	.000
35	26	75,336											.000	.000
36	27	73,018											.000	.000
37	28	72,520											.000	.000
39	29	71,408											.000	.000
40	30	70,515											.000	.000
41	31	70,505											.000	.000
42	32	69,535											.000	.000
43	33	69,170											.000	.000
44	34	67,939											.000	.000
45	35	64,668											.000	.000
46	36	63,000											.000	.000
47	37	60,344											.000	.000
48	38	58,895											.000	.000
49	39	56,613											.000	.000
50	40	56,313											.000	.000
51	41	56,102											.000	.000
52	42	53,980											.000	.000
53	43	53,820											.000	.000
54	44	45,454											.000	.000
56	45	33,699											.000	.000
57	46	30,400											.000	.000
58	47	165,818				1	1				2	2	6.031	.012
59	48	106,680				1	1				2	2	9.374	.019
60	49	46,673				1	1				1	1	21.426	.021
62	50	205,943				2	2				6	6	9.711	.029
63	51	53,322				1	1				2	2	18.754	.038
66	52	162,980				2	2				11	11	12.271	.067
67	53	189,494				4	4				13	13	21.109	.069
69	54	45,963				1	1				4	4	21.757	.087
70	55	118,336				1	1				12	12	8.451	.101
71	56	79,652				1	1				10	10	12.555	.126
72	57	132,122				1	1				19	19	7.569	.144
74	58	84,856				2	2				13	13	23.569	.153
75	59	61,227				2	2				11	11	32.665	.180
76	60	267,079				3	3				49	49	11.233	.183
77	61	10,465				1	1				2	2	95.557	.191
80	62	141,059				1	1				33	33	7.089	.234
79	63	119,872				4	4				26	26	33.369	.217
81	64	101,288				1	1				24	24	9.873	.237
82	65	87,193				2	2				21	21	22.938	.241
83	66	113,273				2	2				28	28	17.656	.247
84	67	139,105				1	1				37	37	7.189	.266
85	68	37,372				1	1				10	10	26.758	.268
86	69	197,991				6	6				54	54	30.304	.273

GROUP 5.—ACCIDENT DATA FOR CERTAIN *QUARRIES AND OPEN PIT MINES* IN 1929[1]

Code No.	No.	Hours worked	Number of accidents					Number of days lost					Frequency[2] rate	Severity[2] rate
			Fatal	P. T.	P. P.	Temporary	Total	Fatal	P. T.	P. P.	Temporary	Total		
88	70	148,719				2	2				45	45	13.448	.303
90	71	223,240				8	8				69	69	35.836	.309
91	72	86,074				1	1				30	30	11.618	.349
92	73	84,587				2	2				30	30	23.644	.355
93	74	231,066				5	5				89	89	21.639	.385
96	75	177,273				16	16				73	73	90.256	.412
97	76	74,314				2	2				31	31	26.913	.417
98	77	35,817				2	2				15	15	55.839	.419
99	78	90,527				1	1				38	38	11.046	.420
100	79	82,984				5	5				35	35	60.253	.422
101	80	116,440				4	4				50	50	34.352	.429
104	81	215,078				2	2				99	99	9.299	.460
105	82	67,232				2	2				31	31	29.748	.461
106	83	118,923				5	5				57	57	42.044	.479
108	84	207,985				6	6				103	103	28.848	.495
111	85	212,835				4	4				110	110	18.794	.517
114	86	320,788				8	8				177	177	24.939	.552
115	87	177,466				6	6				98	98	33.809	.552
116	88	123,296				2	2				68	68	16.221	.552
117	89	84,013				4	4				47	47	47.612	.559
118	90	175,978				2	2				99	99	11.365	.563
120	91	1,526,930			1	36	37			600	285	885	24.232	.580
122	92	327,724				7	7				196	196	21.359	.598
123	93	46,818				1	1				30	30	21.359	.641
126	94	95,769				6	6				63	63	62.651	.658
127	95	75,847				1	1				50	50	13.184	.659
128	96	68,229				7	7				45	45	102.596	.660
131	97	58,048				2	2				45	45	34.454	.775
134	98	64,961				4	4				53	53	61.575	.816
136	99	152,280				1	1				129	129	6.567	.847
138	100	138,604				6	6				127	127	43.289	.916
139	101	84,788				6	6				79	79	70.765	.932
142	102	123,384				7	7				120	120	56.733	.973
145	103	84,999				2	2				85	85	23.530	1.000
146	104	51,967				2	2				54	54	38.486	1.039
148	105	112,375				1	1				120	120	8.899	1.068
154	106	877,266			1	69	70			360	678	1038	79.793	1.183
155	107	95,952				4	4				117	117	41.688	1.219
158	108	98,549				8	8				131	131	81.178	1.329
161	109	72,263				2	2				99	99	27.677	1.370
162	110	130,524				8	8				181	181	61.291	1.388
163	111	24,356				1	1				34	34	41.058	1.396
164	112	258,889			1	10	11			300	63	363	42.489	1.402
166	113	114,465				13	13				168	168	113.572	1.468
168	114	123,211				10	10				192	192	81.162	1.558
173	115	179,096			1	1	2			300	1	301	11.167	1.681
176	116	83,390				1	1				142	142	11.992	1.703
182	117	86,237				2	2				163	163	23.192	1.390
194	118	84,194				2	2				194	194	23.755	2.304
201	119	198,661				9	9				502	502	45.303	2.527
202	120	216,677				19	19				551	551	87.688	2.543
203	121	50,807				3	3				130	130	59.047	2.559
204	122	63,426				2	2				163	163	31.533	2.570
213	123	68,849				4	4				224	224	58.098	3.253
231	124	115,139			2	4	6			600	42	642	52.111	5.576
257	125	380,713			1	18	19			4500	396	4896	49.906	12.860
270	126	47,790			1	1	2			800	11	811	41.850	16.970
276	127	211,590			2	9	11			3900	225	4125	51.987	19.495
279	128	88,313			1		1			1800		1800	11.323	20.382
297	129	149,002	1			11	12	6000			217	6217	80.536	41.724
298	130	178,727	1		1	1	3	6000		2400	33	8433	16.785	47.184
299	131	124,968	1			3	4	6000			25	6025	32.008	48.212
300	132	124,261	1			4	5	6000			212	6212	40.238	49.992
301	133	116,017	1			6	7	6000			70	6070	60.336	52.320
302	134	105,447	1			1	2	6000			4	6004	18.967	56.939
303	135	314,586	3		1	44	48	18000		300	494	18794	152.581	59.742
304	136	94,841	1				1	6000				6000	10.544	63.264
306	137	90,555	1			1	2	6000			28	6028	22.086	66.567
307	138	89,857	1			2	3	6000			5	6005	33.386	66.828

GROUP 5.—ACCIDENT DATA FOR CERTAIN *QUARRIES AND OPEN PIT MINES* IN 1929[1]

Code No.	No.	Hours worked	Number of accidents					Number of days lost					Frequency[2] rate	Severity[2] rate
			Fatal	P. T.	P. P.	Temporary	Total	Fatal	P. T.	P. P.	Temporary	Total		
309	139	152,900	2	.....	1	.....	3	12000	.....	2400	.....	14400	19.621	94.179
310	140	37,755	1	.....	.....	.....	1	6000	.....	.....	.....	6000	26.487	158.919
311	141	67,018	2	.....	.....	5	7	12000	.....	.....	293	12293	104.450	183.428
1929 Totals and averages		19,752,418	17	.....	14	498	529	102000	.....	18,260	9,053	129,313	26.782	6.547
1928 Totals and averages		20,152,034	13	.....	11	567	591	78000	.....	15,600	11,352	104,952	29.327	5 208

[1] As the accident reports from mining companies are considered confidential by the Bureau of Mines, the identities of the mines to which this table relates are not revealed.

[2] Frequency rate indicates number of fatal, permanent, and other lost-time accidents per million man hours of exposure; severity rate indicates number of days lost from accidents per thousand man hours.

Note: P. T. means permanent total disability; P. P. means permanent partial disability; and Temp. means temporary disability.

	Number of mines	Man hours	Injuries	Days of disability
Anthracite mines	29	31,098,493	3,152	328,541
Bituminous coal mines..	68	33,668,473	2,321	389,566
Metal mines	54	18,116,618	945	108,512
Nonmetallic mineral mines	19	3,897,004	121	30,374
Quarries and open-cut mines	141	19,752,418	529	129,313
Total, 1929.....	311	106,533,006	7,068	986,306
1928.....	284	91,746,707	6,109	900,182
1927.....	256	91,919,812	6,645	866,021
1926.....	256	95,055,815	7,313	799,493
1925.....	210	68,418,283	6,848	580,895

From these figures the following accident rates were calculated:

	Frequency rate	Severity rate
Anthracite mines	101.355	10.565
Bituminous coal mines	68.937	10.571
Metal mines	52.162	5.990
Nonmetallic mineral mines	31.049	7.794
Quarries and open-cut mines.....	26.782	6.547
Average	66.346	9.258

The accident-frequency rates indicate the number of fatal, permanent, and temporary lost-time injuries for each million man-hours of exposure to hazard. The accident-severity rates indicate the number of days of disability caused by all fatal, permanent, and temporary lost-time injuries per thousand man-hours of exposure to hazard.

A comparison of the accident rates for 1929 with those for the previous year shows that accidents at anthracite mines increased in frequency, owing to an increase in temporary injuries, but that the severity rate was reduced slightly, owing to a decline in fatalities and permanent partial disabilities. The rates for bituminous mines were reduced both as to frequency and severity in all classes of injuries except permanent total disabilities. Metal mines as a group accomplished no reduction in accident frequency but made a marked reducton in the accident-severity rate by lessening the number of fatalities, bringing about a reduction large enough to overcome increased severity rates for all classes of nonfatal injuries. Nonmetal mines effected a material reduction in accident frequency and a smaller reduction in accident severity; the improvement was especially notable in temporary injuries. The group which included quarries and open-cut mines reduced its accident-frequency rate but suffered an increase in its severity rate on account of an increase in fatalities and permanent partial disabilities, an increase which more than counterbalanced a reduction in the rate for temporary injuries.

46 Plants in Quarry Group Make Perfect Record

Editor's Note: Due to lack of space only the winner in the quarry group is given.

Among the 311 mines and quarries that participated in the contest, 57 were operated without a lost-time accident. Several of these plants, however, fell below the requirements of the contest rules, either by being in operation less than 150 days or by having less than 50 men employed underground or 25 inside the quarry or open-cut mine. These plants thus became disqualified as formal contenders for the award of the trophy. However, figures for all mines and quarries are included in Tables 3 to 7. The 57 plants which operated without a lost-time accident in 1929 worked 7,344,219 man-hours, representing 7 per cent of the total number of man-hours worked by the 311 mines and quarries. In the group which included 141 quarries and open-cut mines, 46 plants worked 5,701,000 man-hours without a lost-time accident, representing 29 per cent of the total number of hours worked at the 141 plants in the group.

(*Continued on page* 24)

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New Records Established in Accident Prevention

NOTABLE have been the accomplishments in the quarry industry in the field of accident prevention during 1929, as indicated by the National Safety Competition for that year, the results of which have recently been made public and are included in this issue of the *Journal*.

Out of 141 quarries and open cut mines entered in the Competition, 46 completed the year with no lost-time accidents, a truly significant denial of the conception far too prevalent in the crushed stone industry that accidents cannot be eliminated. In 1926 out of 118 plants entered in the Competition, 14 completed the year with no lost-time accidents; in 1927, out of 132 entrants, 29 made perfect records; and in 1928, out of 128 plants, 34 joined this distinguished company.

Such cumulative evidence cannot be denied and if read sympathetically and intelligently should convince those who are still inclined to the belief that it can't be done, that they have overlooked a most promising field which only requires concentrated and intensive development to yield a real dollars and cents profit.

That the number of companies within our industry who are seriously becoming interested in accident prevention work is constantly increasing, is evidenced by the figures given above which show a steadily growing number of entrants in the National Safety Competition each year. This number should continue to increase and will only do so through energetic cooperation both as individuals and as an association.

Our 1931 Hosts

AFTER an interval of seven years, the National Crushed Stone Association will return to St. Louis for its Fourteenth Annual Convention to be held on January 19-22, 1931. To those of our industry who enjoyed the pleasure of attending the Association's Seventh Annual Convention held in St. Louis in 1924 the decision of the Board to return to that city will be most welcome.

Seven years may perhaps seem to be a long time but not too long to dim the memory of the charming hospitality and gracious courtesy extended by our St. Louis hosts in 1924, and we know that they will leave nothing undone to make our second St. Louis convention even more profitable and enjoyable than its predecessor.

St. Louis is adequately served by excellent equipped trains from all sections of the country and can be reached by a large percentage of the industry by little more than an over-night ride.

We are also particularly fortunate in having located in St. Louis and the territory adjacent thereto a strong local group, the St. Louis Quarrymen's Association, which is already enthusiastically making its plans to give us a reception such as has neven been equalled before. We also understand that E. J. Krause, a prominent member of the local group and known throughout the entire industry for his ardent and enthusiastic support of the National Association will act as Chairman of the Entertainment Committee. We are not as yet familiar in detail with his plans, but from one or two hints which have been given we can predict without fear of exaggeration that to those who attend our Fourteenth Annual Meeting the word "entertainment" will take on a new significance.

The New Hotel Jefferson, designated as headquarters for the convention is adequate in every particular to meet our more or less exacting needs. It has just recently been remodelled, particularly with regard to the convention space, so that it will now be possible to concentrate all convention activities on the mezzanine floor, just one floor above the lobby. Such an arrangement is ideal and will contribute greatly to the convenience and pleasure of the delegates attending the meeting.

The Manufacturers' Division Exposition of Quarry Equipment and Machinery which each year becomes a more important and interesting feature of the convention can be admirably housed on the mezzanine floor immediately adjacent to all other convention activities. Thus the exposition is assured of a maximum attendance and the delegates are permitted to view the exposition with the least inconvenience.

For thirteen years the foremost producers of crushed stone throughout the United States and Canada have been foregathering in annual convention. An institution has thus been established the value of which to the crushed stone industry is beyond measure. A mark of progress for any industry is the ability of its members to organize; to cooperate; to lay aside petty and selfish interests; to meet, discuss and solve those common problems necessary for the advancement of all. To repeat—crushed stone producers have been doing this for thirteen years and with increasing effectiveness as each year goes by. And the occasion of our Fourteenth Annual Meeting will prove no exception.

Confident in the belief that only through organized cooperative effort can an industry hope to continue to prosper, crushed stone producers from far and near will lay aside their daily tasks and travel to St. Louis next January.

Make your plans now to be at the New Hotel Jefferson, St. Louis, January 19-22, 1931.

Sixth International Road Congress

TO study United States methods of road improvement and use, the leading highway engineers, administrators and economists of the world will meet in Washington for attendance at the Sixth International Road Congress, October 6 to 11.

Representatives from more than fifty nations will participate in the discussions according to responses to invitations received by the State Department. In addition to those who come from foreign countries a large number of delegates from the United States will be present to confer with their foreign colleagues.

The Congress will be held under the general auspices of the Permanent International Association of Road Congresses, which maintains headquarters at Paris, and under the immediate direction of the American Organizing Commission, the members of which were named by the Secretary of State. The President of the Commission is Roy D. Chapin, motor executive, of Detroit, While Thos. H. MacDonald, Chief of the U. S. Bureau of Public Roads, is Secretary-General. J. Trueman Thompson, professor of Civil Engineering at the Johns Hopkins University, Baltimore, has recently been named manager of the Congress.

Other members of the Organizing Commission are: Wilbur J. Carr, Assistant Secretary of State; Thomas R. Taylor, Department of Commerce; Robert P. Hooper, American Automobile Association; Henry G. Shirley, American Association of State Highway Officials; Charles M. Upham, American Road Builders' Association; A. J. Brosseau, Chamber of Commerce of the United States; H. H. Rice, Highway Education Board.

The agenda and program of the Congress embrace the principal questions of highway construction, administration, maintenance, and finance that are the concern of authorities the world over. These problems have been discussed in numerous papers submitted by the leading authorities on the respective subjects. These papers and the conclusions drawn from them have been translated into the four official languages of the Congress, French, German, Spanish and English, and are now ready for distribution to the members of the Permanent International Association. The reports include 76 printed leaflets. It is on the basis of these reports that the principal discussions of the Congress will arise. The program of the Congress calls for the first plenary session at Constitution Hall on the afternoon of Monday, October 6, to be followed by section meetings at the headquarters of the Congress, which have been established at the building of the Chamber of Commerce of the United States. The headquarters of the Commission, in preparation for the Congress are at 1723 N Street, N. W.

Two excursions, one to Mount Vernon and another to Annapolis are on the program for the week.

Simultaneous with the Congress an international exhibition of road machinery will be held under the direction of the American Road Builders' Association,

which also has provided for outdoor space where practical demonstrations will be given.

The general reporters who have consolidated the concensus of opinion as expressed by world authorities, and the subjects they will discuss are: Mr. Frank T. Sheets, Chief Highway Engineer, Division of Highways Springfield, Illinois, "Results obtained by the use of cement"; Mr. P. J. Freeman, Chief Engineer, Department of Public Works, Allegheny County, Pittsburgh, Pennsylvania, "Results obtained by the use of brick and other artificial paving"; Mr. Roy W. Crum, Director, Highway Research Board, National Research Council, Washington, D. C., "Recent methods adopted for the use of tar, bitumen and asphalt in road construction"; Mr. Edwin W. James, Chief, Division of Highway Transport, Bureau of Public Roads, Washington, D. C., "Construction of roads in new countries and colonies"; Col. A. B. Barber, Manager, Transportation and Communication Department, Chamber of Commerce of the United States, Washington, D. C., "Ways and means of financing highways"; Dr. Henry R. Trumbower, Professor of Economics, University of Wisconsin, Madison, Wisconsin, "Highway transport, correlation and coordination with other methods of transport"; and Dr. Miller McClintock, Director, Albert Russel Erskine Bureau for Street Traffic Research, Harvard University, Cambridge, Massachusetts, "Traffic regulation in large cities and their suburbs, and parking and garaging of vehicles."

Participation in the Congress is limited to members of the Permanent International Association of Road Congresses. Details of membership may be had of the Secretary General, American Organizing Commission, 1723 N Street, N. W., Washington, D. C.

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The circus strong man rode out on horseback to challenge a farmer whose great strength had gained him a reputation. He entered the farmyard, tied up his horse and approached the farmer.

"Hey", he said, "I've heard a lot about you, and have come a long way to see which is the better man."

Without answering the farmer seized the intruder, hurled him bodily over the fence into the road and returned to his work.

When the loser had recovered his breath the farmer growled, "Have you anything more to say to me?"

"No", was the reply, "but perhaps you'll be good enough to throw me my horse."—*The American Boy*

* * * * * * * * * *

Hubby: "The blueberry pie tastes queer, dear."

Wifey: "Oh, honey, perhaps I put too much blueing in it."—*Clipped.*

Stephens-Adamson Move New York Office

The Stephens-Adamson Mfg. Co., Aurora, Ill., engineers and manufacturers of conveying and elevating machinery, announce the removal of their New York sales and engineering office to 50 Church St., Room 1360.

Increased Highway Construction Contributes to Business Stabilization

The Secretary of Commerce recently expressed the opinion that the great increase in early-season highway construction is a matter of national moment, representing a substantial contribution to the stabilization of business.

First-quarter contract awards for state highway construction showed a net increase of more than 124 per cent over the corresponding period of last year, according to reports to the Secretary from the Governors of thirty-five States. The figures, which cover about 75 per cent of the country, show contracts valued at $114,101,383, against $50,910,133 for the same period last year. The greatest relative increases are reported in Ohio and Idaho; Ohio awards for the first quarter being approximately eleven times and Idaho awards over ninety times larger this year than last. Pennsylvania reports contracts valued at $15,469,853 for the first quarter, against $2,282,813 for the same period of last year, an increase of 577 per cent.

The Assistant Secretary of Commerce pointed out in a recent radio talk that the increase in expenditures by State and Federal Governments for rural highways has increased from a little more than $2,500,000 in 1904 to more than $827,000,000 in 1928, the most recent year for which complete statistics are available. This is in addition to the road expenditures of counties and other local governments, which in 1928 reached a total of $832,000,000.

As an illustration of the specific business benefits from roads, Dr. Klein cited the case of North Carolina, which between 1919 and 1926 constructed $125,000,000 worth of highways. To this is attributed in part the fact that the true value of North Carolina property multiplied eight times between 1900 and 1926, while the entire country was increasing the value of property but four times. Among other benefits reported are large increases in the number of farms in the State, when for the country as a whole they were decreasing the number, the rapid development if cooperative farm marketing associations, and a great increase in tourist traffic and in the number of motor-vehicle registrations.

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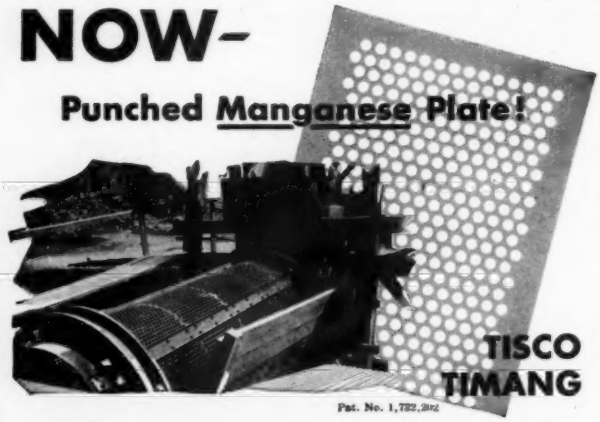
NOW—

Punched Manganese Plate!



Pat. No. 1,732,262

PRODUCERS of aggregate are familiar with the long service and outstanding economy of manganese steel screen cloth.

Now, for the first time, punched manganese plate is also available for screening operations; in thicknesses from ½" down to 16 gauge, and in any size and pitch of perforation.

This improved screen plate is made from TISCO TIMANG, the 14% manganese steel which cold works readily, yet possesses the same wear-resistance as the cast manganese steel so extensively used for the wearing parts of your heavy duty equipment.

It will pay you to try this improved TIMANG punched manganese plate for your next requirement. In every installation to date, it has appreciably lowered screening costs by far outlasting ordinary plate.

TISCO TIMANG SCREEN CLOTH

TIMANG Manganese Steel Screen Cloth is available in any mesh or clear opening and any wire size from .148" dia. to 1" dia. For special purposes TIMANG wire as small as .003" dia. can be furnished.

TAYLOR-WHARTON IRON AND STEEL CO.

HIGH BRIDGE, NEW JERSEY

SALES OFFICES: Pittsburgh, Chicago, Houston, Montreal, New York, Philadelphia, Boston, San Francisco, Scranton, Tampa, Los Angeles

The National Safety Competition of 1929

(*Continued from page* 19)

Winner in Quarry Group

EDITOR'S NOTE.—Due to the lack of space only the winner—the Quarry Group, is given.

The fifth group for which a trophy was awarded included quarries and open-cut mines, regardless of the kind of mineral produced. The trophy for the best record in this group was won by the Michigan Limestone and Chemical Co.'s limestone quarry at Rogers City, Mich., which worked 753,156 man-hours during 1929 without a lost-time accident. All mines and quarries within the group worked 19,752,418 man-hours and had an accident-severity rate of 6.547 and and accident-frequency rate of 26.782.

The average duration of disability resulting from temporary injuries in 1929 was 21.6 days, as compared with 22.3 days in the previous year's contest. This average "healing period" varied from 27.5 days for bituminous coal mines to 18.1 days for anthracite mines and 18.2 for quarries and open-cut mines. Comparative figures showing the average length of disability from temporary injuries at mines and quarries of the National Safety Competition in 1928 and 1929 are as follows:

	1928, days	1929, days
Anthracite mines	20.7	18.1
Bituminous coal mines	26.2	27.5
Metal Mines	17.7	20.9
Nonmetallic mineral mines	15.7	21.6
Quarries and open-cut mines	20.0	18.2
	22.3	21.6

Records of the National Safety Competition of 1929 confirm those of previous years which showed that most mining and quarrying companies have better safety records than are indicated by the average figures for all mines as a group. For example, 88 per cent of the properties in the quarry and open-cut mine group in the safety contest of 1929 had accident-severity rates lower than 6.547, which was the average rate for the group. Sixty-six per cent of the properties in the same group had accident-frequency rates lower than 26.782, the average rate of the group. Similar percentage figures for each group showing the proportion of plants having better records than the group average, are given below.

	Frequency rate		Severity rate	
	1928	1929	1928	1929
Anthracite mines	45	59	55	66
Bituminous coal mines	62	60	62	72
Metal mines	60	56	75	78
Nonmetallic mineral mines	53	58	79	74
Quarries and open-cut mines	68	66	87	88
Total	67	71	75	79

Pavement Design Will Be Tested by U. S. Bureau of Public Roads

To determine the relative efficiency of several designs of concrete pavements and to develop more exact knowledge of the amount and distribution of stress in pavement slabs resulting from loads applied to them in various positions, the Bureau of Public Roads of the U. S. Department of Agriculture is constructing numerous full-size concrete pavement slabs at the Experiment Farm of the department at Arlington, Va. The slabs will later be subjected to an elaborate series of tests.

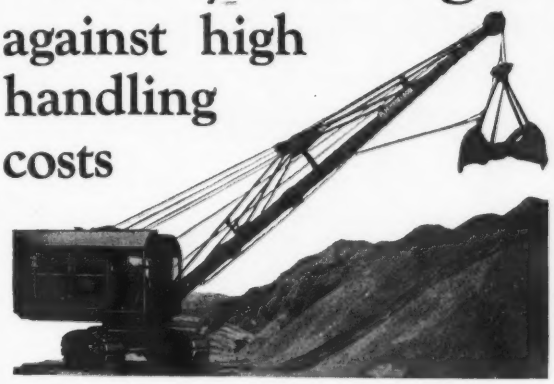
Some slabs will be of uniform thickness throughout. Tests on these are expected to furnish information regarding the relation between loads applied at various points and the stress and strain of the concrete at all points in the loaded cross section, and the relation between load resistance and slab thickness.

Other slabs will be thickened at the edges and for a certain distance from the edges in accordance with the different designs now used in several States. In some slabs the thickening will be provided for by excavating the subgrade under their edges. In others the surface of the concrete slab will be raised at the edges so as to form a low, rounded lip curb. In still others the lip curb will be combined with a thickening of the edge of the slab at the bottom. Observations of these sections will furnish information regarding the relative load-resisting properties of designs now in use in various States.

The test slabs, which will be 20 feet wide by 40 feet long, will have central longitudinal and transverse joints. The object of one test is to determine the efficiency of various methods in use for transferring load across these joints.

Other experiments will include bond tests of dowel bars to determine the length of embedment necessary; the measurment of subgrade friction, with particular attention the effect of edge thickening of transverse joints on resistance to the sliding of the slabs on the supporting surface; and the measurement of the movement of the slab in the subgrade as a result of temperature and moisture changes.

Win your fight against high handling costs



Your fight against high handling costs never ends. But you can win it . . . win it with speed.

P & H Corduroy Cranes are built to stand up continuously under their own maximum speed. And they are fast. Take the 1 cubic yard size for example . . . line speed, 180 feet per minute; rotating speed, 4 r. p. m.; single line pull, 15,300 lbs., all under easy, instantaneous, positive control, and available day in and day out for years.

In short, a P & H Corduroy Crane is an effective weapon against high cost of material handling. For further information write the

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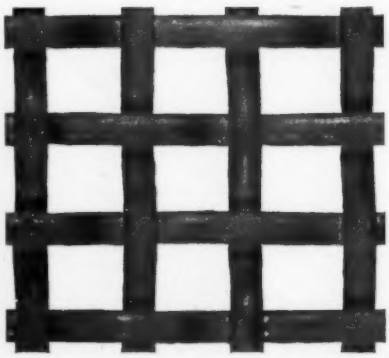
ROK-TEX HAS PROVED ITS SUPERIORITY



Progressive stone crushing plants all over the country are adopting ROK-TEX as the standard of excellence for all rock and stone screening purposes. Built for dependable service, every part that goes into its manufacture is planned to stand up under all the strains, jars, and poundings connected with stone screening.

ROK-TEX is woven on improved power looms from special analysis steel wire either plain or galvanized. Galvanizing is done after weaving to insure extra-dependability and still longer life. That these manufacturing precautions are justified is shown by the fact that actual working tests made in some of the country's largest quarries have definitely proven that *Buffalo ROK-TEX Wire Cloth has from* 50% *to* 200% *longer life than ordinary wire screening.*

You'll find it extremely profitable to follow the example set by other progressive stone crushing plants when you place your next order. Buffalo ROK-TEX Wire Cloth is made in all standard sizes. Special sizes may easily be woven to order.

A letter to us stating your requirements will bring full information, samples and prices.

BUFFALO WIRE WORKS CO.

(INCORPORATED)

585 Terrace — *Formerly Scheeler's Sons, Est. 1869* — BUFFALO, N. Y.

PERFORATED METAL SCREENS

The quality of CROSS Screens gives longer service, increased production and lower cost.

CATALOG ON REQUEST.

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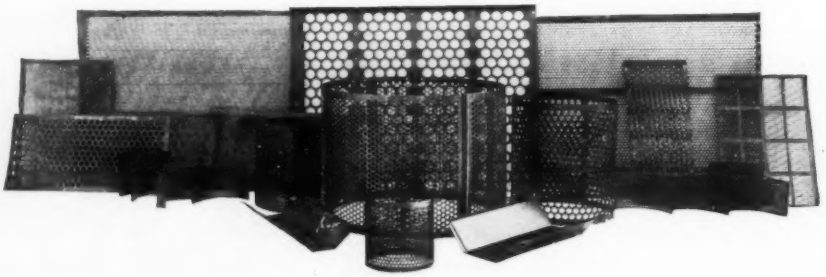

Rush Orders often Shipped within twenty-four hours

CROSS ENGINEERING CO.

CARBONDALE, PA.

15 OUT OF 22

Outside boom and inside handle—the type of front end equipment that has dug *twenty times* more than all others combined. Standard on all Marions

FIFTEEN out of twenty-two shovel manufacturers selected Marion inside dipper stick design. These companies came into the field after years of service of both inside and outside types of handles—they had no traditions to uphold and were free to select the best. Results proved the inside handle to be most satisfactory. They last longer, are more flexible and dig better.

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Shovels, Draglines, Cranes, 1 yd. to 20 yds.

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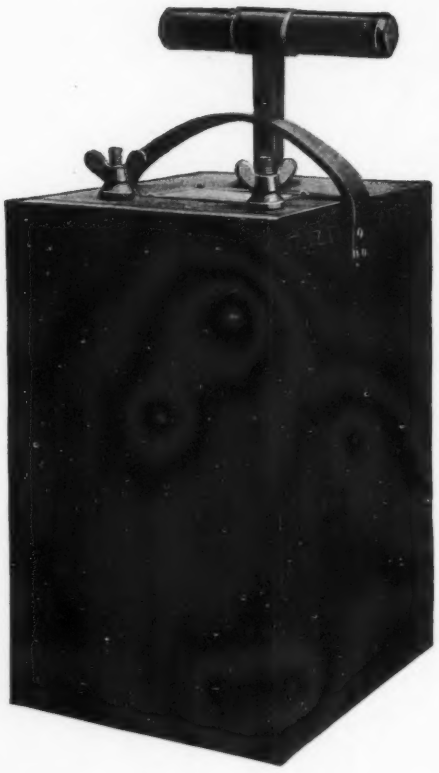
ATLAS BLASTING MACHINE

1 to 50 SHOT CAPACITY



THE purpose of a Blasting Machine is to convert muscular energy into electrical power that may be used to fire a series of Electric Blasting Caps . . . . . Ten years' experience has assured us that the fundamentals of design of the Atlas No. 3 Blasting Machine are correct. Refinements in design have been made from time to time, thereby increasing the efficiency and durability of this machine, but no radical changes have been made.

As a general rule, factors other than the capacity of the blasting machine limit the number of Electric Blasting Caps that may be successfully fired in series. Under ideal conditions, which seldom ever exist in the field, the Atlas No. 3 Blasting Machine has consistently fired one hundred and fifty Atlas 30-ft. Copper Wire Electric Blasting Caps in a single series. However, we prefer to be conservative and rate this machine at fifty Electric Blasting Caps of the same character wire and length in single series.

Larger, heavier, and more expensive blasting machines can be designed than the Atlas No. 3, but we are satisfied, through the experience we have gained, that a more durable and a more dependable machine than the Atlas No. 3 cannot be obtained.

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WILMINGTON, DELAWARE

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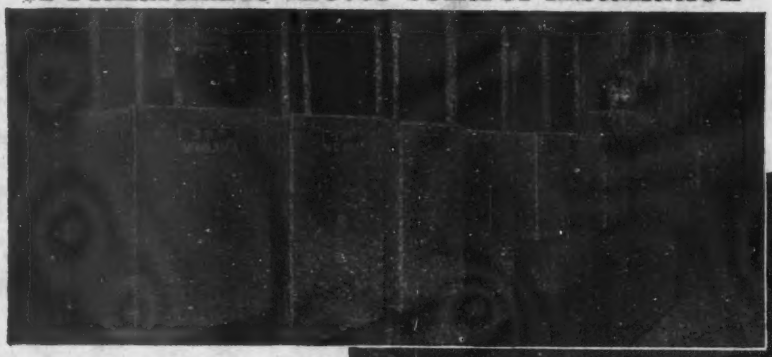
ATLAS EXPLOSIVES

At the G-E Motorized Plant of the France Slag Company

A remarkable motor-control installation



Control room, France Slag Company, Toledo, Ohio

Motors that run in drifts of dust

One of the G-E totally enclosed, fan-cooled motors driving a magnet belt

ALL the control compactly arranged in one room. The entire flow sheet started and stopped in sequence at the touch of one button on the ground floor. Safety provided by emergency stop-buttons located on every floor. All the motors totally enclosed, fan-cooled — operating reliably day after day in drifts and clouds of abrasive dust.

This is the type of electrification the rock-products plant can obtain when G-E Motorized Power is selected. To specify G-E Motorized Power is to obtain: (1) the correct motor for each machine and each service condition; (2) the correct control for each motor; (3) the coördination of motors, controller, and machinery to achieve maximum production at the lowest operating cost. Information and service are always available at a nearby G-E office.

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—fitted to every need

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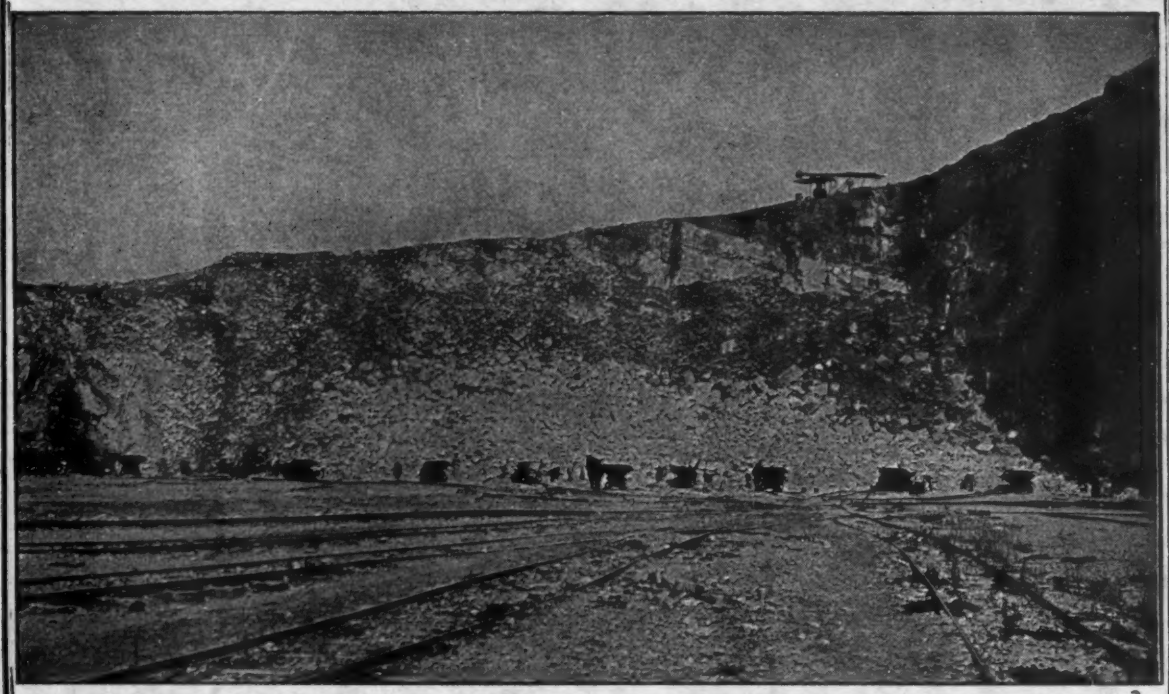

CORDEAU Helps Improve the Fragmentation

CORDEAU, by speeding up the rate of detonation of the explosive charges in a blast, adds materially to the shattering effect of the explosive no matter whether it is a high grade dynamite or the slower blasting powders. Rock well broken, toe kicked out, little secondary blasting, and crushing units well supplied with rock mean good operating conditions and consequent profit for the quarry operator.

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